1 Project title

Combining generative models from Deep Learning with maximum likelihood estimators: Better answers from poorer data!

2 Brief Description of Design Project Goals

Overview: Generative Adversarial Networks (GAN) in Deep Learning have been quite successful in providing Deep Neural Networks that accurately represent particular image domains (e.g., human faces\(^1\)). When solving an inverse problem, such as a tomography problem, if you have a good description of the image domain that contains the answer then you can compute a fixed-quality approximation to the answer using poorer quality data. In a tomography problem, the data could be poorer quality in many senses including lower signal-to-noise ratio, larger angular sampling interval, or limited range of angles. Some of these data issues are very important in applications. For instance, in medical X-ray computed tomography, using a lower dose of X-rays is desirable but causes lower signal-to-noise ratio which is undesirable.

The purpose of this project is to test an idea for combining Generative Adversarial Networks with Maximum Likelihood statistical estimators in a tomography problem.

Specific MEng Contribution: Use widely-employed Deep Learning software systems with some additional software “glue” (probably written in Python) to create a software system that achieves particle picking. I would like to write a paper for a computer vision conference like CVPR!

ECE Field Advisor Name: Peter C. Doerschuk

- Email – pd83@cornell.edu.
- Phone – 607-255-4179.
- Office – Phillips 305.

Outside Field Advisor Name (if applicable):

- Email
- Phone
- Office

Project Web Site:

Number of MEng Students Needed: A team of perhaps two.

**Required Skills:** The project needs students with a balance of “algorithms” interests, especially Deep Learning and statistical, and “computation” interests. Hopefully, the large majority of the software will be written using high-level packages, like PyTorch or TensorFlow, in Python. Prior experience with research, not necessarily using these tools, is good!

**Estimated Project Time Frame:** 2018-2019 Academic Year, Two (2) Semesters, 6 credits.